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ABSTRACT

A study tested the effects of between-channel redundancy on television news learning. Redundancy, defined as shared information, was proposed as an explanatory variable that considers the relationship between information in three channels: the audio, the nonverbal pictorial, and visual-verbal print channel. It was hypothesized that pictures would facilitate learning if they reinforced and complemented verbal information, but that adding an additional language channel through captioning would impede learning by forcing a split-attention situation. Network news stories were manipulated to create a 2x2 design with four conditions: (1) redundant pictures and words, (2) nonredundant pictures and words, (3) redundant pictures and words with redundant print, and (4) nonredundant pictures and words with redundant print. Twenty-five undergraduate subjects were assigned to each condition. After viewing the stories, they completed a series of 10 semantic differential-type scales. Results showed that picture-word redundancy increased recall and reduced error, while adding print-impeded learning. The findings suggest that producers should use print information to highlight story concepts and synchronize visuals with their respective word labels. (JL)

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RADIO-TELEVISION JOURNALISM

IMPROVING AUDIENCE LEARNING FROM TELEVISION NEWS THROUGH BETWEEN-CHANNEL REDUNDANCY

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An experiment was designed to test the effects of between-channel redundancy on television news learning. Non-significant and conflicting findings in the broadcast news literature had left unresolved the effect of visuals on learning. Redundancy, defined as shared information, is proposed as an explanatory variable which considers the relationship between information in three channels: the audio, the non-verbal pictorial, and the visual-verbal print channel. It was hypothesized that pictures would facilitate learning if they reinforced and complemented verbal information, out that adding an additional language channel through captioning would impede learning by forcing a split-attention situation. Network news stories were manipulated to create a 2x2 design with four conditions: (1) Redundant pictures and word, (2) non- redundant pictures and words, (3) Redundant pictures and words, with redundant print, and (4) non-redundant pictures and words, with redundant print. Twenty-five subjects were assigned to each condition (N=100). Analysis of variance results show that as hypothesized picture-word redundancy increased recall and reduced error, while adding print impeded learning. Results are discussed as guidelines for producing news stories which enhance audience learning.

Most broadcast news professionals would agree that television journalism should attempt to effectively communicate the important events and issues of the day to viewers. However, broadcasters have traditionally been unconcerned with learning as an audience effect (Robinson, Sahin and Davis, 1981; and Sahin, Davis and Robinson, 1981). Producers, newsgatherers and technicians devote considerable time, energy and expense each day to creating news stories. Newsworkers must decide how to visualize events and provide suitable video for their stories, but the explanatory value and appropriateness of such illustration is largely intuitive.

Although research has examined learning from TV news, we still do not have a very complete understanding of how to most effectively use the medium. This study is designed to add to that understanding by examining the optimal way to combine pictures, speech and the printed word so as to enhance learning.

Information processing theory suggests that redundancy between channels is an important factor. This study, then, focuses on three sources of information found in television news stories: the audio, the visual-verbal print, and the non-verbal pictorial channels.

Cueing theory states that audio-visual redundancy, shared information between channels, facilitates learning because cues are provided from one channel to another (Adams and Chambers, 1962). Hartman (1961) notes that the summation of cues occurs when cognitive associations facilitate linking information units, as in a successful verbal label for an ambiguous picture. Similarly, interference is likely when information between channels is unrelated or when contradictory cognitive relationships are present. Many news stories, unfortunately, fall in the latter category, mismatching visuals with the reporter's script.

There have been many studies of information gain from broadcast news which have attempted to find a general effect for the visual channel. The results have been mixed and inconclusive. As seen below, redundancy may be the explanatory variable which was not considered. Only one study found a film version of a newscast superior to announcer alone (Edwardson, Grooms and Proudlove, 1981), while three found no differences (Hazard, 1962; Jorgensen, 1955; and Edwardson, Grooms and Pringle, 1976). Others have found contingent effects: visuals aid learning among children (Drew and Reese, 1983), among the better educated and for less attractive stories like foreign affairs (Katz, Adoni and Parness, 1977), for some stories in a newscast (McDaniel, 1972), and when event consequences are illustrated (Findahl and Hoijer, 1976).

Edwardson et al (1976), although reporting no differences, provide enough description of the news stories in their experiment to permit speculation that between-channel redundancy may account for their findings. It appears that film had a positive effect on information gain when it reinforced information in the audio channel. For two of the eight stories more correct answers were provided by those seeing the film treatment:

"A roundup of traffic fatalities in Florida over a holiday weekend. The film showed various wrecked cars at roadsides with spectators;" and

"A story about demands by three groups of strikers. The film showed strikers standing belligerently facing persons seated at a table."

It appears that film may have more successfully illustrated the above stories than others in the experiment. While in two stories there were no apparent differences, four others showed detrimental film effects on information gain. Again, we may speculate an unsuccessful, non- redundant film treatment:

"A story concerning new ordinances passed by the local county commissioners to control noise. The film showed commissioners in session with shots of the spectators asking questions."

"A story concerning penalties that Florida universities might suffer through letting students leave school for political campaign work. The film showed students talking, walking and studying outdoors on campus."

"A roundup of baseball league standings before a playoff. The film showed a team workout," and

"A report on bicycle thefts. Film showed bicycles in rows and bicyclists riding in groups."

The film in the last four stories would not appear to adequately reinforce information in the verbal channel.

Picture-word redundancy, then, is expected to increase learning. It is somewhat more difficult to hypothesize the effects of adding redundant print information, although captions do appear useful in highlighting certain story elements (Findahl and Hoijer, 1975). Broadbent's (1958) single-channel theory states that humans can only attend to one source of information at a time. Switching attention from one channel to another is said to hamper processing

performance, since informational inputs from only one sensory modality at a time are said to have access to the higher brain centers.

The present study hypothesizes that pictures complement words, and, as Hsia (1968) notes, the increase in dimensionality from redundant pictorial-verbal information overcomes the limitations of the single channel model. Spoken and printed verbal material, however, even though redundant, may be competing sources of information--since they are both language channels. Captions may also distract attention from the visual images, thus interfering with the beneficial effects of redundant pictorial information. This study experimentally manipulates both redundancy between words and pictures and the presence or absence of redundant print information. Redundancy between print and audio information is not manipulated because these channels are rarely contradictory in news programs.

What subjects remember is examined in terms of correctly recalled information and error (remembering information not transmitted). Note that these measures focus on verbal content and necessarily neglect other sources of affective and impression forming information.

The effect of the experimental manipulations on story evaluations will also be examined, as well as the relationship between those evaluations and learning.

METHODS

Data for this study were gathered in the spring of 1982, using undergraduate subjects at the University of Wisconsin--Madison. The experiment employs a 2x2 factorial design. The two factors are the redundancy between the pictorial and verbal channel(s) and the presence or absence of printed information redundant with the audio channel. Manipulating these factors creates four news message conditions: (1) redundant pictures and

words, (2) non-redundant pictures and words, (3) redundant pictures and words with redundant print information, and (4) non-redundant pictures and words with redundant print information. Twenty-five subjects were assigned to each cell, yielding equal and proportionate cell frequencies (N=100).

Procedure

Several viewing sessions were set up over five days, during the first two weeks of April 1982, and subjects were allowed to select a session at their convenience. The sessions ranged in size from one to eight persons and were assigned to one of the four experimental conditions until each of the four cells of the design contained 25 subjects, an attempt to randomize the subjects to the four treatments.

In each condition of the actual experiment, subjects were told they were participating in a study of television news formats, and that they would be shown four different stories, one right after another, with a short pause between each one. They were told that, although the stories were not arranged in the form of a newscast, they were to listen and watch as if they were watching the nightly news on television. Each viewing session took place in a quiet room with chairs arranged such that each subject was about eight feet from the screen. The total viewing time was 14 minutes, after which questionnaires were distributed.

Measures

Stimulus Materials. Several evening, morning and magazine news programs were videotaped in February 1982. Four stories were retained for the experiment, three to be manipulated and one to act as a non-manipulated "dummy" story. A major criterion in choosing the stories was how well the pictures illustrated verbal content (e.g., El Salvador guerillas blow up a bridge, several shots of the mangled bridge are shown; a newsmaker is mentioned, and we see him or her on the screen).

The non-manipulated first story was reported by Sander Vanocur, announcing the release of logs from the Kennedy library (story length--2:04). Jack Smith reported the second story concerning a propaganda offensive by El Salvador guerillas (2:11). Tom Jarriel narrated the third story from ABC's 20/20 news magazine program, dealing with problems on the Israeli- occupied West Bank Territory (5:11). The final story, regarding the Middle East, was reported in tandem by Bill Seamons in Jerusalem and Barry Dunsmore at the State Department, with introductions by Frank Reynolds in Washington and Peter Jennings in London.

The non-manipulated Kennedy story was used to get subjects warmed up to viewing and to serve as a check on subject randomization. It and the West Bank story were shortened, editing out "soundbites," film of speaking newsmakers. Following the Kennedy tapes story, subjects in each condition saw the El Salvador report, followed by the West Bank and U.S./Israel stories. A three-second pause was inserted between each story.

Manipulations. The three stories (other than the Kennedy story) were used to operationalize redundant pictures and words. Manipulating this relationship was accomplished by re-editing camera shots within each story, so as to disrupt the synchronization between pictures and words-- minimizing jarring discontinuities between shots, yet still effecting a strong manipulation. In many cases original sequences of shots were retained but simply moved to a different part of the story. Completely dispersing shots throughout the story would have been unnecessary and possibly would have led to negative subject program evaluations.

For the most part existing video in each story was simply reordered, such that each report retained its original visuals. This technique, however, was not sufficient to strongly manipulate some portions of the El Salvador and West Bank stories. When the visuals were reordered there was still a good

relationship between some parts of the story and corresponding pictures. Because the programs were not long, the variety of camera shots was limited, and redistributing the shots did not take them too far afield from the reporter's script. Visuals from a similar report (also by Jack Smith) were substituted for some shots in the El Salvador story. In the West Bank story some visuals were used from the longer 20/20 report.

This substitution technique helped strengthen the manipulation by providing a source of unrelated visuals to edit into the original stories. Although generally unrelated to verbal content, they pertained broadly to story subject matter (i.e., substituted visuals were still shot in El Salvador and the West Bank). For the most part, however, the redundant and non-redundant versions contained the same visual information--it was simply distributed in a different order.

A validity check was made on the manipulation in two stages. Of 10 judges, five were shown the related and non-related versions of each of the three manipulated stories in the following order: El Salvador (redundant, non-redundant), West Bank (non-redundant, redundant) and U.S./Israel (redundant, non-redundant). The other five were shown the same story order but with the sequence of treatments reversed. When instructed to choose the story version that was most successful in providing visuals related to and reinforcing the reporter story, there was complete inter-judge agreement as to which were the redundant treatments.

For a more refined measure of the manipulation's success, individual segments of each program were rated. Four judges were told they would be shown two different visual treatments of the same verbal material. For each story segment they were to rate how redundant they thought the pictures were with the words on a 20-point scale, ranging from -10 to +10. For each of the two treatments, nine discriminations were made for the El Salvador story, 13

for the West Bank report and 10 for the U.S./Israel story, for a total of 64.

The judges were shown all three stories in one condition, stopping the tape after each segment. At each stop they made a mark on the scale, near -10 if they felt the pictures contradicted the words, near +10 if they felt the pictures reinforced the words, and near zero if they perceived a neutral relationship. They were then shown the other treatment of the three stories and responded in the same fashion. Two saw the redundant treatment first while two saw the reverse order.

Each rating for a non-redundant treatment segment was subtracted from the corresponding rating for the redundant treatment of that segment, such that a positive number indicated a successful manipulation. Each segment's difference score (the mean of the difference scores of the four judges) was positive. Three portions of the U.S./Israel story were not manipulated and thus, by definition, their difference scores were zero (introductions by Frank Reynolds and Peter Jennings and standup report by Bill Seamons).

Printed material was added to the three manipulated stories in the form of two-line captions in the lower third of the screen. The captions represented a complete transcription of each story and appeared on the screen at the same rate the reporter spoke. Captioning the three original stories (not including the dummy story) and their non-redundant versions, created two other conditions completing the 2x2 design.

Subjects evaluated each of the four programs on a series of 10 semantic differential- type scales. They marked their opinion on the following seven-point adjective pairs: interesting/boring, amateur/ professional, confusing/clear, exciting/dull, difficult/easy, informative/ not informative, believable/unbelievable, accurate/inaccurate, unreliable/ reliable, and easy-to-watch/difficult-to-watch.

In addition, for each story, they indicated on a five-point scale whether they found themselves concentrating "mainly on the pictures," or "mainly on the reporter's words," with "on both picture and words" the midpoint.

Multiple choice tests on the stories were used to operationalize how much each subject remembered from the programs. For each question there was one correct answer, although several plausible alternatives were constructed based on possibly confusing visuals. Subjects had the option of marking "don't remember." Subjects also marked confidence scales for each item, indicating how sure they were about each response, ranging from 0 percent, "not at all sure," to 100 percent, "completely sure." The confidence value was automatically defined as 0 percent if they marked "don't remember."

In order to ensure internal consistency among the test items for each story, the reliability alpha was computed for each set of questions. Responses were dummy coded--0 for failing to remember or erring and 1 for answering correctly. Alpha was also computed using the confidence value instead of 1, if the the question was answered correctly. As seen in the following respective alpha values, the confidence measure improves reliability in all but one case: Kennedy Tapes (.34, .52), El Salvador (.68, .76), West Bank (.67, .67) and U.S./Israel (.62, .75). It is, therefore, used to weight the percent remembered score employed below, such that a 100 percent score would require all answers correct with total certainty.

Subject prior knowledge of story topics was tested by having them check a percentage scale, ranging from 0 percent, meaning they were not informed at all, to 100 percent, meaning they were very well informed. For each story, recall was the number of correct answers and error the number of incorrect responses.

RESULTS

The effects of the experimental manipulations were tested using analysis of variance. Results show that, overall, redundant pictures and words enhance learning, while adding redundant print information either has no effect or detracts from learning. (The degrees of freedom for the F statistics below are 1 and 99)

Figure 1 shows the graph of cell means for percent of recall. Note that unless otherwise noted the results are for the three manipulated stories and do not include questions from the Kennedy "dummy" story. Redundant pictures and words improve recall, $F=4.9$, $p=.02$, but the effect of adding print is non-significant. It is in the El Salvador story that adding print information impedes recall, $F= 6.0$, $p=.02$ (Figure 2).

In figure 3 the effects on error are shown. Again, redundant pictures and words have a positive effect, $F=5.9$, $p=.02$, while the overall print effect is non-significant. Again in the El Salvador story, however, print exerts a negative effect, $F=7.0$, $p=.01$ (Figure 4).

Figures 1 through 4 about here

Prior knowledge was examined as a possible contaminating influence on study results. Entering it as a control variable in analyses of covariance show a predictably strong positive effect, improving recall ($F=26.5$, $p=.005$) and reducing error ($F=5.5$, $p=.02$), but the effects of the experimental variables are essentially the same as reported above.

Tables 1 and 2 about here

The experimental manipulations did not have a strong overall effect on program evaluations. In only one of the stories were there significant differences. In the El Salvador report, picture-word redundancy improved ratings of professionalism, $F=6.9$, $p=.01$. Adding print had a negative effect on ratings of clarity, $F=3.1$, $p=.08$; easiness, $F=7.6$, $p=.01$; and reliability, $F=3.8$, $p=.05$.

The results show that for the El Salvador story print impeded learning, and subjects in the print condition evaluated the story negatively. This suggests a positive relationship between learning and evaluations. This can be seen in correlations between these variables (shown in Table 1). In general, evaluations are positively correlated with recall and negatively with error.

This pattern of positive correlations does not hold up as well for the Believability, Accuracy and Reliability evaluations. The correlations of those evaluations with the learning measures are generally low and/or in the opposite direction. This suggests that they represent a separate dimension on which viewers evaluate news programs which may be distinct from other evaluations of clarity, informativeness, etc. Generally, though, viewers seem to evaluate more highly those programs from which they learn the most. Note that prior knowledge is strongly related to both positive evaluations and higher learning scores. Table 2, however, shows that when partialling out the effect of prior knowledge, there are still significant positive relationships between learning and many of the evaluation dimensions.

Another correlation of interest is that between channel concentration and evaluations of believability and accuracy (.29 and .32). Focusing on [illegible] visuals may enhance the documentary flavor of the story, supporting the old "seeing is believing" adage.

DISCUSSION

Results clearly show benefits for at least one source of redundancy. Learning improves when the pictorial and audio channels are redundant and reinforce each other, increasing recall and decreasing errors. Adding redundant print information, however, appears to impede learning.

Multi-channel redundancy cannot be thought of as the additive effect of the individual channels. We see that the three-way combination of redundant print, aural and visual information is no better than the original two-way audio-visual arrangement, and is significantly worse in one story.

Although captioning had negative results throughout the experiment, the effects were particularly strong in the El Salvador story, in which subjects were confronted with captions for the first time. The fact that the negative effects were mitigated in subsequent stories suggests that viewers were initially distracted by the captions, but were later successful in tuning them out (a few wrote negative comments about "the captions for the hearing impaired"). This also suggests why the picture-word redundancy effect was not strong in that story ($F=2.8$, $p=.09$ for recall and $F=1.3$, $p=.25$ for errors). The captions apparently drew attention away from the pictorial channel, "washing out" differences between the redundant and non-redundant treatments. The beneficial effects for reinforcing visuals could not occur if viewer attention was focused elsewhere.

Viewers can process redundant information through the audio and pictorial channels, but learning decreases when receivers attempt to process an additional source of information through the print channel--supporting Broadbent's attention theory. Splitting attention between two language channels, though redundant, results in information loss. As Reynolds and Flagg (1977) suggest, humans cannot process multiple inputs simultaneously when system demand is high. Apparently the news programs in this experiment

presented such a demand through their complexity and constant pace.

Although research suggests that captions aid learning, this may be because they appear irregularly, clueing viewers to important information. This experiment used complete program captioning for a strong manipulation, but given the findings, producers would be advised to use print information to highlight story concepts. If more complex material is desired, it should be presented separately or with simple symbols, and not forced to compete with film for viewer attention.

Findings also suggest that it is not enough to provide visuals that are broadly related to verbal content. The best results occur when those visuals are synchronized with their respective word labels. The fact that differences were found using a somewhat subtle manipulation underlines this finding. Since essentially the same visual information was present in all conditions, synchronization becomes the key factor.

Examining program evaluations shows that viewers scarcely noticed the re-editing manipulation. Only in the El Salvador story did subjects rate the related versions higher, and then on only one dimension. The fact that these negative evaluations did not carry over to the final two programs suggests more strongly that viewers were able to overlook the captions.

It is interesting that on only one evaluation in only one story did viewers negatively evaluate the re-editing, suggesting that the manipulation was not overly obvious. On one hand, this was encouraging since a heavy-handed treatment might have confounded the results. On the other, is indicates that viewers accept news pictures, regardless of how appropriate they are. The fact that a picture is there may carry its own documentary proof that it somehow should be there.

Now that a general effect for picture-word redundancy has been supported,

further research should explore specific benefits for different types of content. For instance, what are the effects of illustrating a story core, or event, as well as the event antecedents and consequences? Portraying the actual event is the easiest approach, but television news has been criticized for focusing too heavily on the actor, rhetoric and location, and not doing enough to contextualize events. Between- channel redundancy may be useful in emphasizing contextual news antecedents and consequences.

This study used pooled-judge opinion to validate the redundancy manipulation, but this technique should be refined to reach a more precise definition. If a sentence is taken, for example, and illustrated pictorially, where would visual representation be most helpful, or contradictory? Should the nouns be represented by their visual referrants and verbs portrayed with film movement? Because news visuals so often show "moving" public figures (dignataries arriving, leaving, etc.) it would be useful to know if this movement distracts from the story, presuming that the report is not about their comings and goings but about their actions and speeches.

As noted earlier, broadcast executives have traditionally been more apt to pursue healthy news ratings than overly concern themselves with audience understanding. The findings discussed above, however, show that learning is related to many of the story evaluations. Devoting more attention to a comprehensible newscast may lead directly to more positive audience regard for the news organization and its product. These events might then have the happy result of satisfying profit- minded managers and social scientists as well.

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Figure 1: Graph of Cell Means. Effects of Picture-Word Redundancy and Adding Print on Recall (Combined Stories)

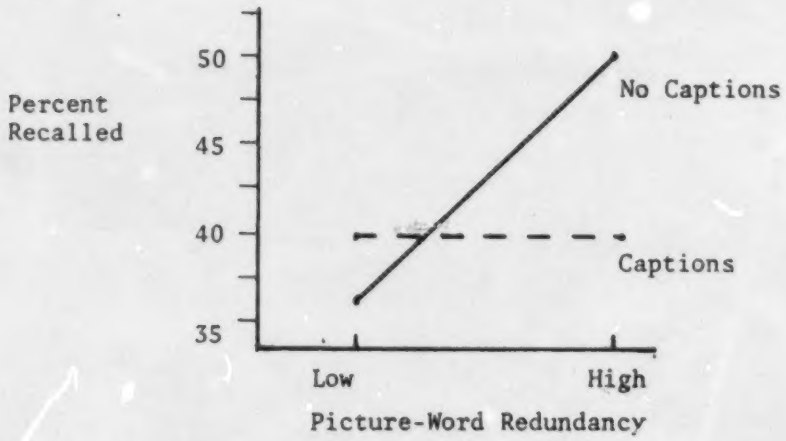

Figure 2: Graph of Cell Means. Effects of Picture-Word Redundancy and Adding Print on Recall (El Salvador Story)

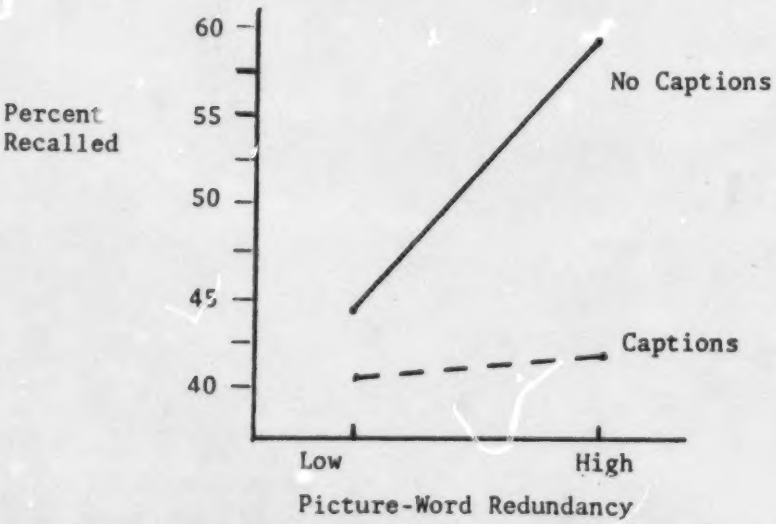

Figure 3: Graph of Cell Means. Effects of Picture-Word Redundancy and Adding Print on Errors (Combined Stories)

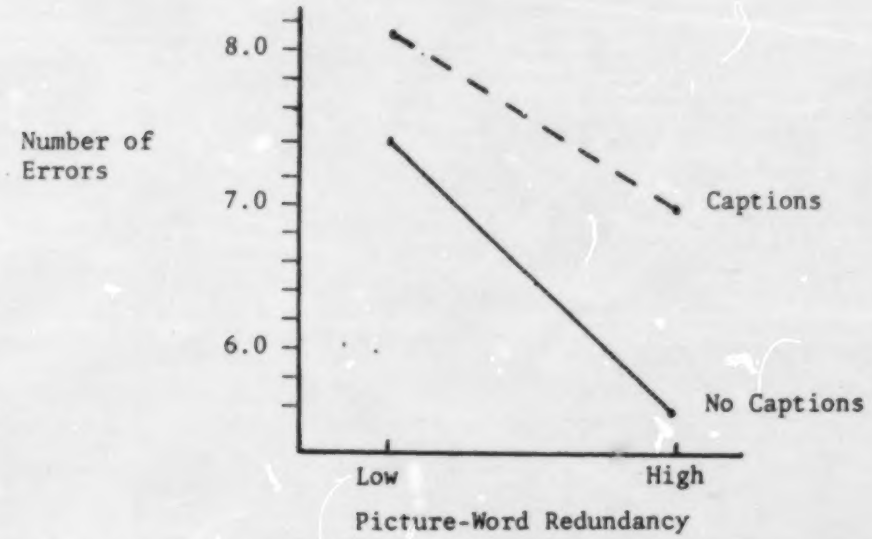

Figure 4: Graph of Cell Means. Effects of Picture-Word Redundancy and Adding Print on Errors (El Salvador Story)

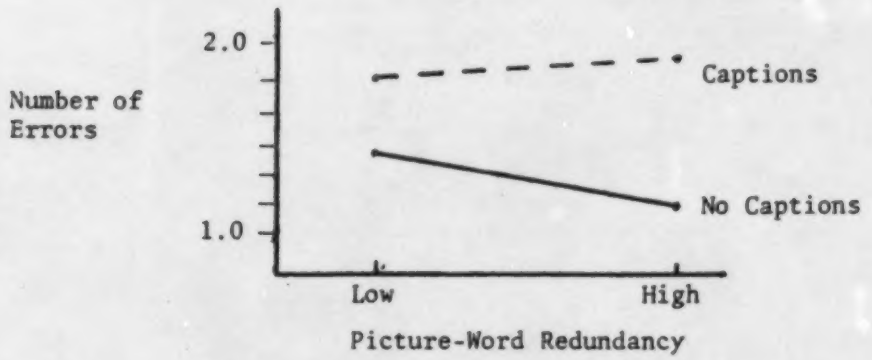

Table 1: Correlation Matrix for Study Variables (Combined Stories)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Interesting[a]	-												
2. Professional	.36	-											
3. Clear	.47	.49	-										
4. Exciting	.64	.26	.37	-									
5. Easy	.43	.39	.75	.34	-								
6. Informative	.40	.51	.35	.34	.31	-							
7. Believable	.29	.24	.26	.16	.15	.38	-						
8. Accurate	.07	.26	.22	.10	.12	.35	.59	-					
9. Reliable	.08	.33	.30	.06	.20	.24	.41	.67	-				
10. Easy-to-Watch	.46	.38	.56	.44	.49	.28	.10	.03	.11	-			
11. Channel Concentration[b]	-.06	.06	-.16	-.17	-.14	.10	.29	.32	.10	-.11	-		
12. Prior Knowledge	.44	.15	.38	.30	.34	.11	-.03	-.04	.19	.28	-.22	-	
13. Errors	-.24	-.17	-.21	-.02	-.33	-.12	.00	.22	-.02	-.20	-.01	-.23	-
14. Recall	.44	.24	.40	.18	.46	.17	.03	-.12	.07	.14	-.02	.45	-.78

Correlations and corresponding significance levels:

.13 p=.10

.17 p=.05

.23 p=.01

[a] Evaluations, Knowledge and Concentration measures are averages of the three manipulated stories.

[b] Higher values mean concentrating more on the pictures.

Table 2: Partial Correlations for Evaluations, Recall and Errors, Controlling for Prior Knowledge (Combined Stories)

	Recall	Errors
1. Interesting	.30	-.16
2. Professional	.20	-.15
3. Clear	.28	-.15
4. Exciting	.00	.05
5. Easy	.37	-.28
6. Informative	.14	-.10
7. Believable	.05	.00
8. Accurate	-.11	.22
9. Reliable	.00	.01
10. Easy-to-Watch	.25	-.15

Correlations and corresponding significance levels:

.13 p=.10

.17 p=.05

.23 p=.01